

Alternative Configurations to Optimize Lead-Acid Batteries for Renewable Generation and Storage (RGS)

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**The project is managed by Sandia National Labs with Stan
Atcitty as Project Manager. Paul Butler and Garth Corey of
SNL also collaborate on the project.**

What are RGS Battery Alternative Configurations?

- **Added circuitry between each string of battery and DC terminals of AC-DC-AC converter**
- **Hardware and software to control currents to/from strings through the additional circuitry**
- **String current control on basis of measured parameters and battery characteristics**

Alternative Configurations to Optimize Lead-Acid Batteries for RGS

Project Goals

To conceive, develop, and promote implementation of, alternative configurations for renewable generation and storage systems that will improve reliability, enhance component performance, and lower life-cycle-costs

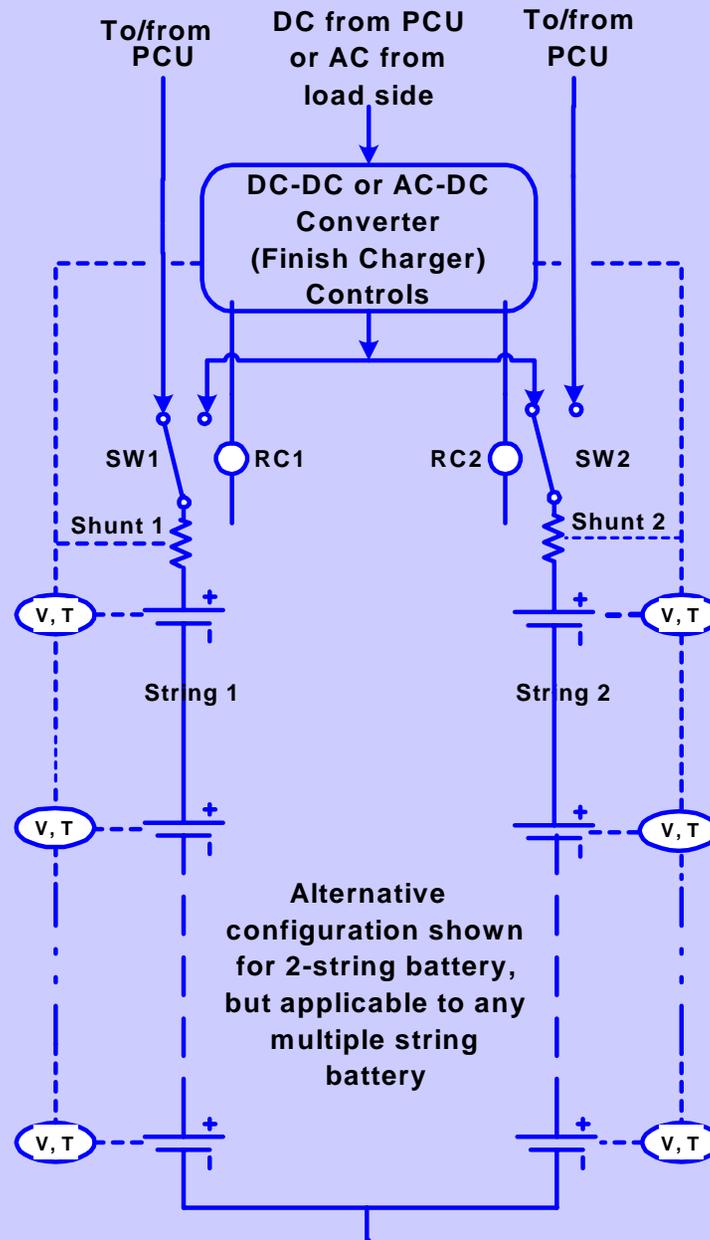
Secondary Goal

To facilitate communication between battery manufacturers and RGS users, using the alternative configurations developed, so that batteries might be used to their best advantage without compromising system performance

Project Approach

- **Conceptualize solution to problems that batteries in RGS do not perform as expected and require maintenance charges using generator (FY98)**
- **Develop AltConfigs as solution, with lab testing & modeling to confirm validity (FY99-00)**
- **Identify user test site; refine hardware/software; install and test in lab and in field (FY00-01)**
- **Identify implementer, and perform joint engineering development/field testing (FY02 Plan)**

Alternative Configurations Involve Two Interrelated Ideas



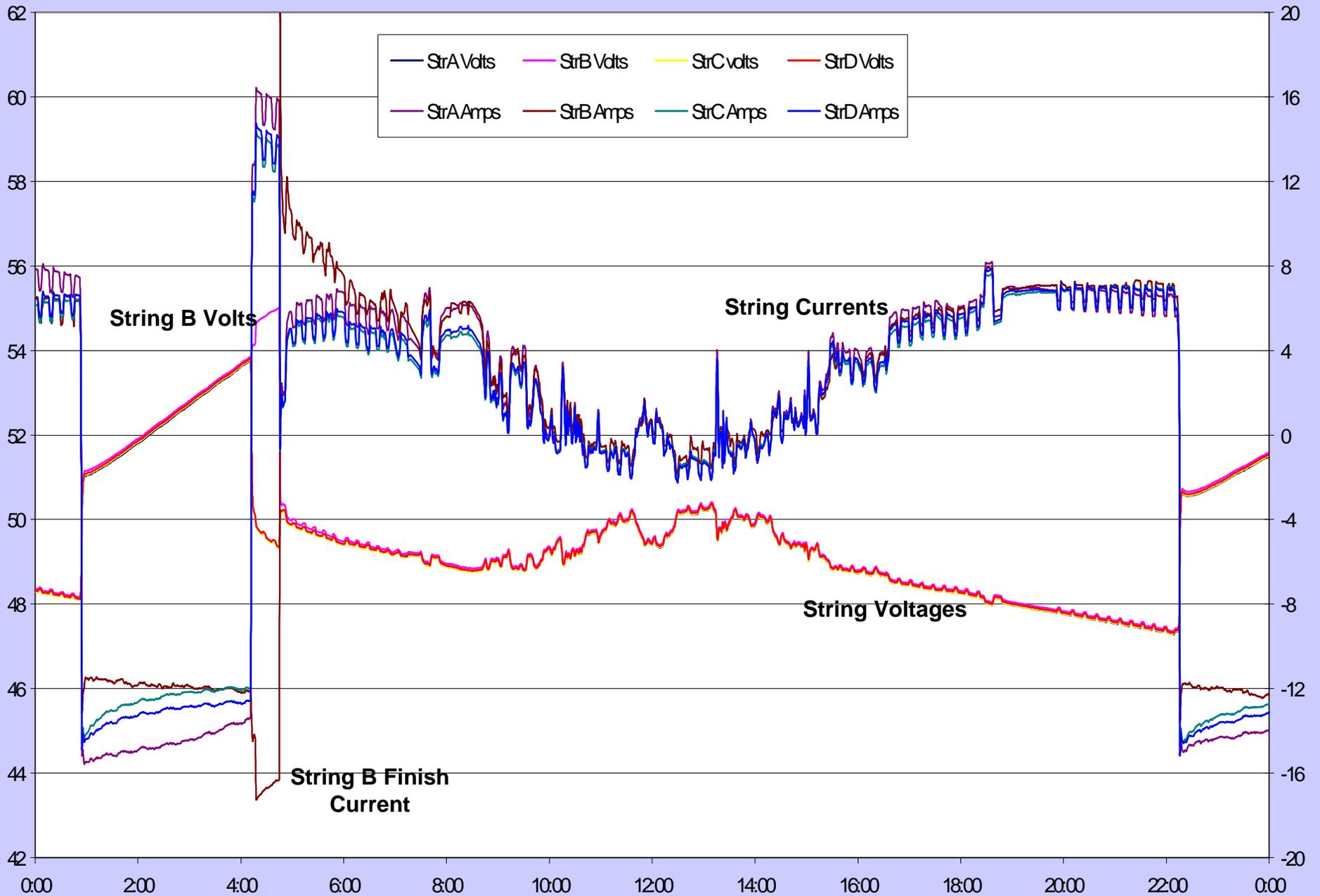
Benefits of Alternative Configurations For Solar Hybrid Systems (RGSs)

- **Battery finishing charge & generator “de-coupled”**
- **Can utilize PV for and while finish charging**
- **Easily made smart relative to expected load & solar**
- **Generator-start on weakest modules**
- **Module volts and temp’s to control finish charging**
- **Opportunity to maximize battery and system life, performance, and to minimize life-cycle-cost**

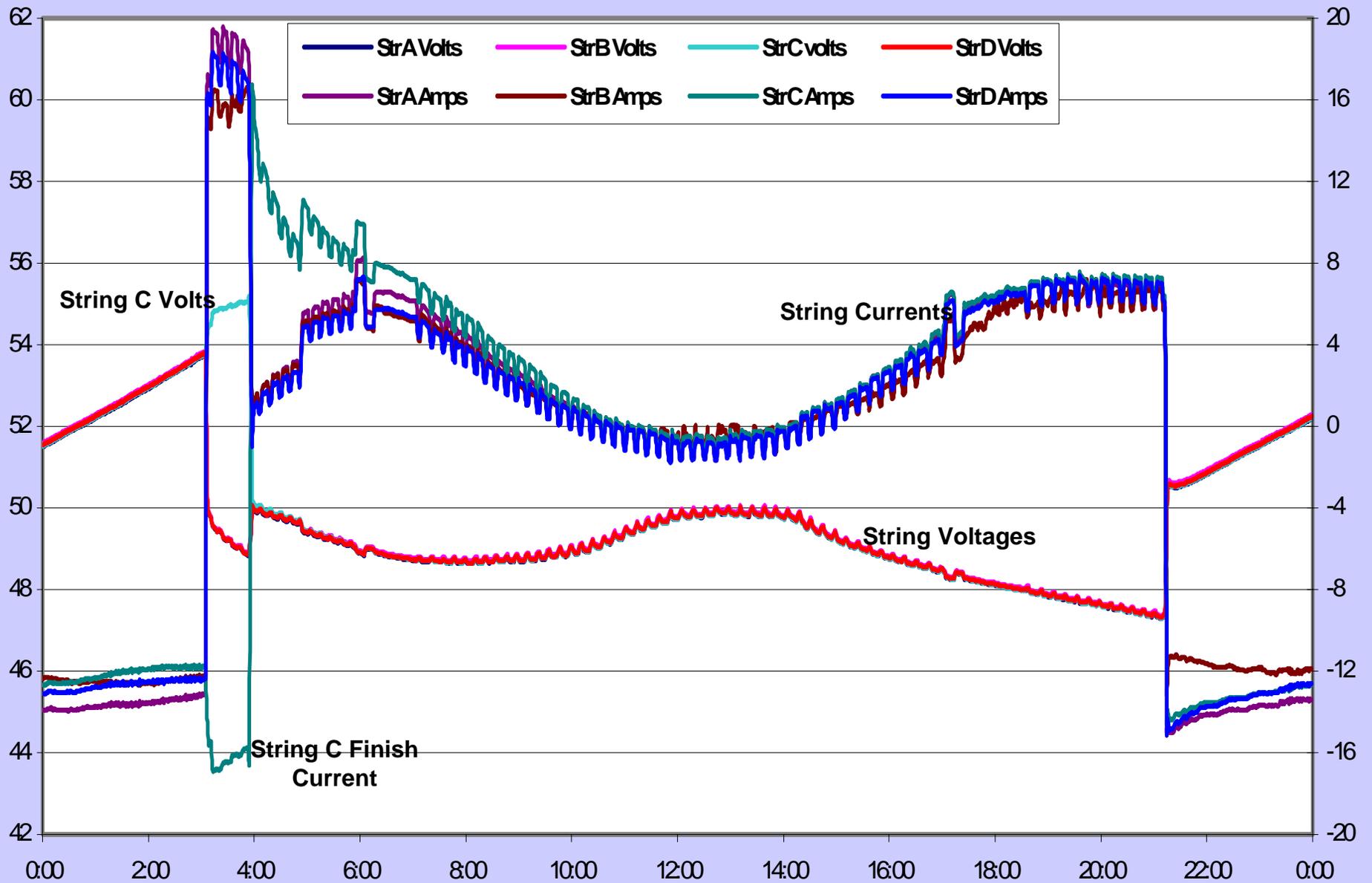
AltConfigs FY01 Progress #1

- **Type I hardware and software improved: Better packaging. More robust, tighter code.**
- **Number of electronics components reduced by 30% while improving operability.**
- **Incorporated embedded processor (PC104) into Type I AltConfigs unit.**
- **After testing at EECl, installed improved unit with 4-string, 48V flooded lead acid battery in hybrid remote power system, which includes PV, propane-generator, PCS.**
- **Loads attached in this field test include a refrigerator, lights on timer, swamp cooler, for a total of ~1.5kW.**

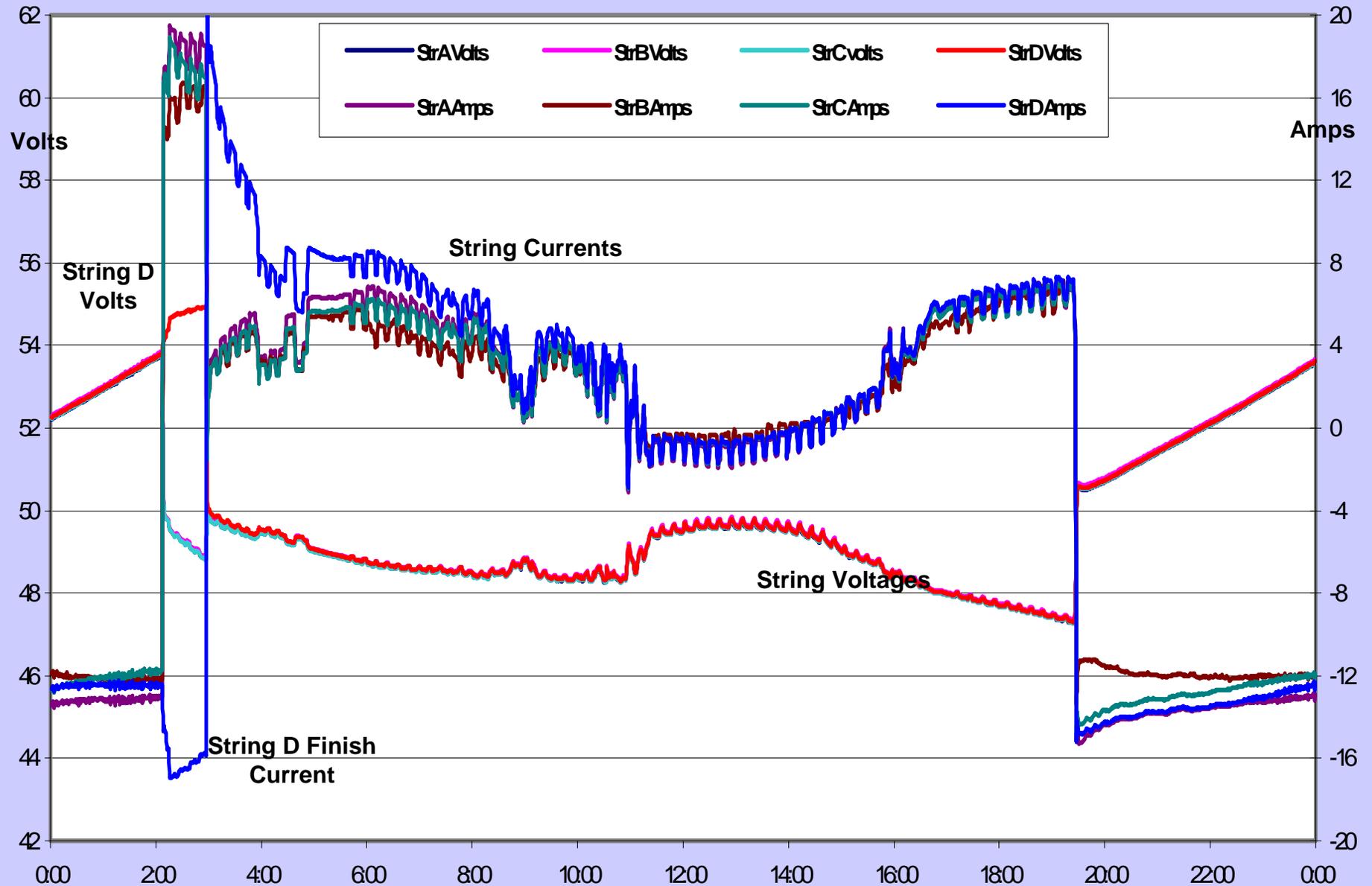
08/10/01 All loads on. Generator on at ~1AM, off at ~4AM, Finish Charge ended at ~5AM



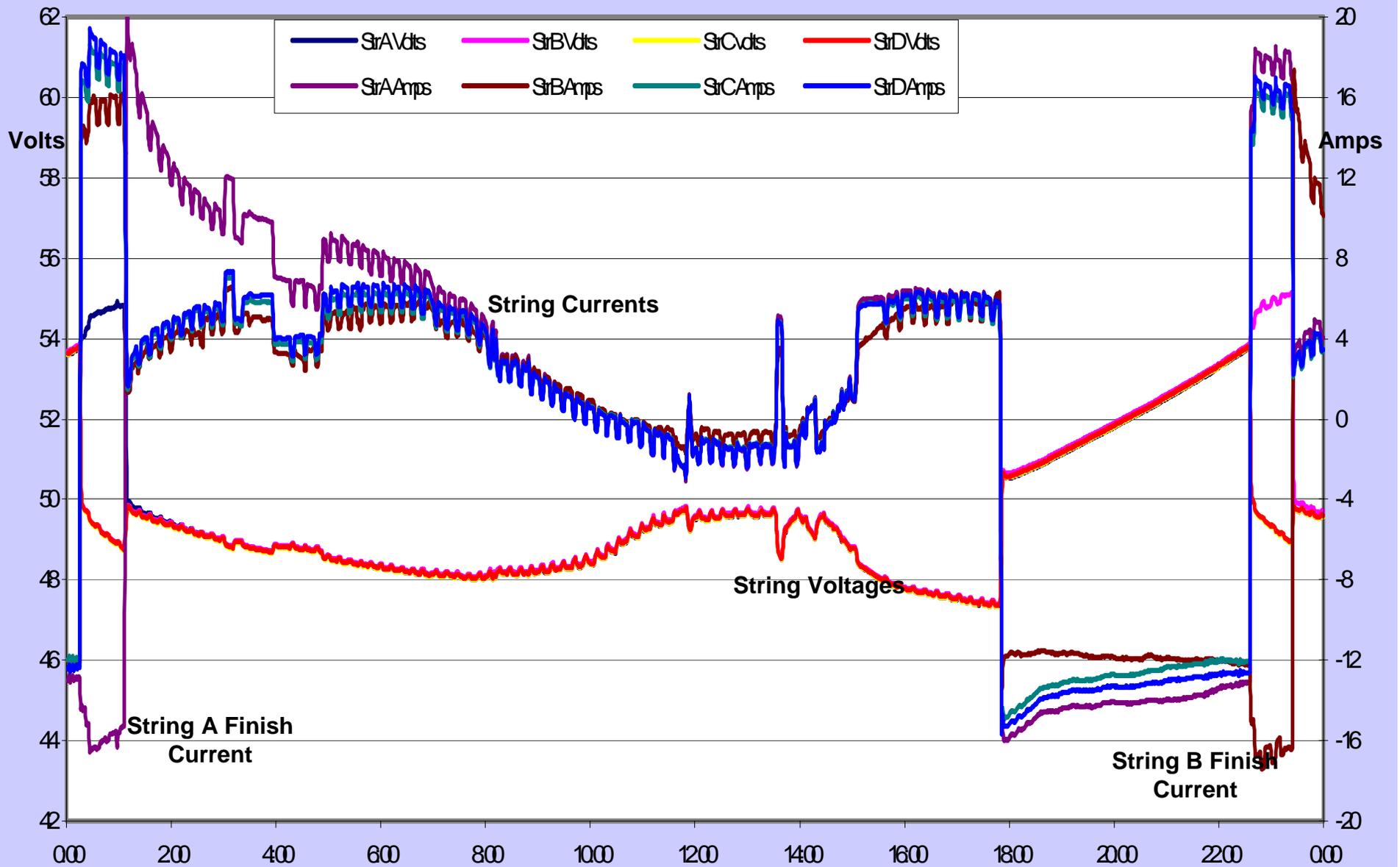
08/11/01 All loads on. Generator off at ~3AM, Finish Charge ended at ~4AM, Generator on at ~9PM



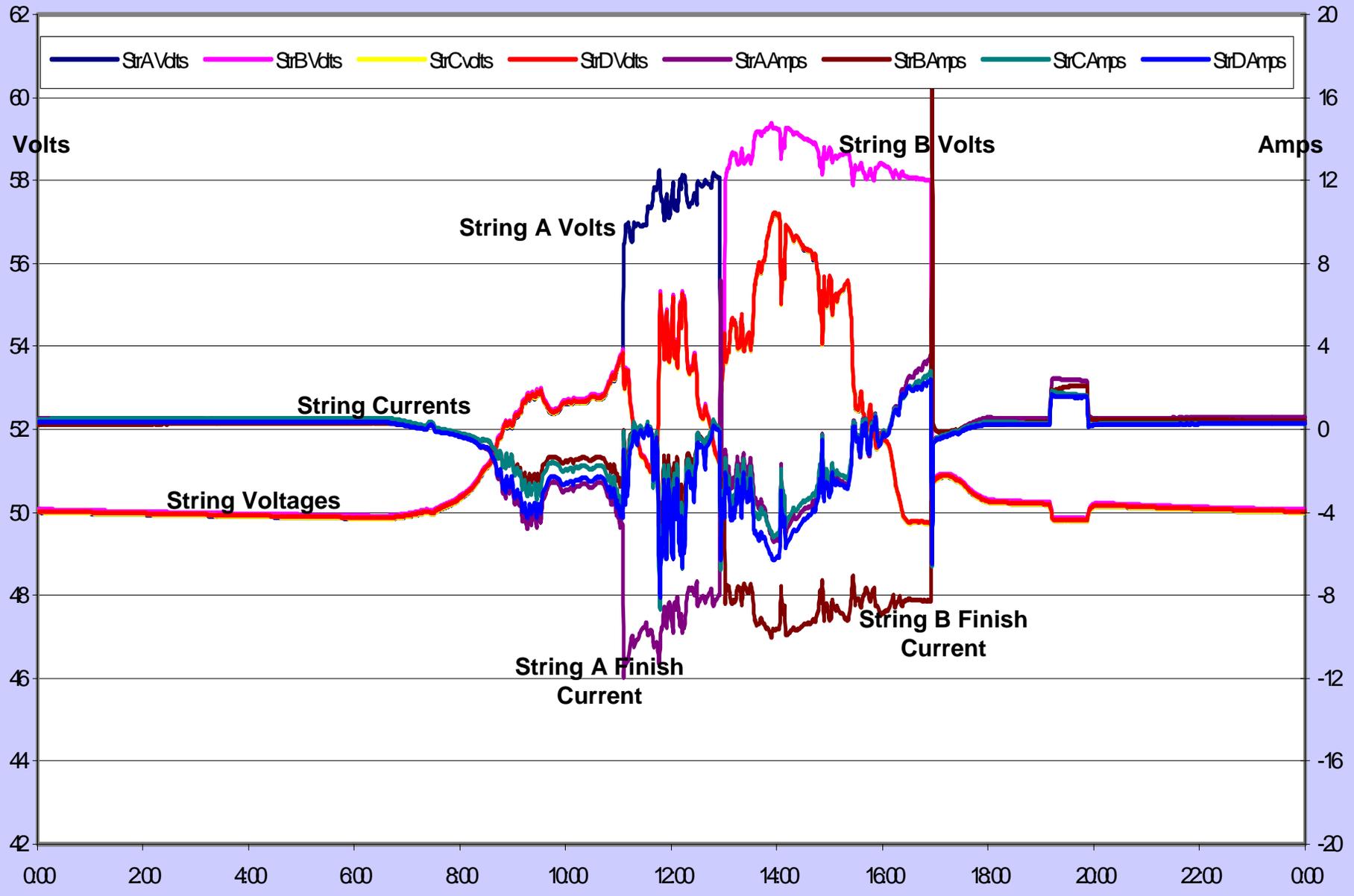
08/12/01 All loads on. Generator off at ~2AM, Finish Charge ended at ~3AM, Generator on at ~7PM
Discharge currents shown positive, charge currents negative.



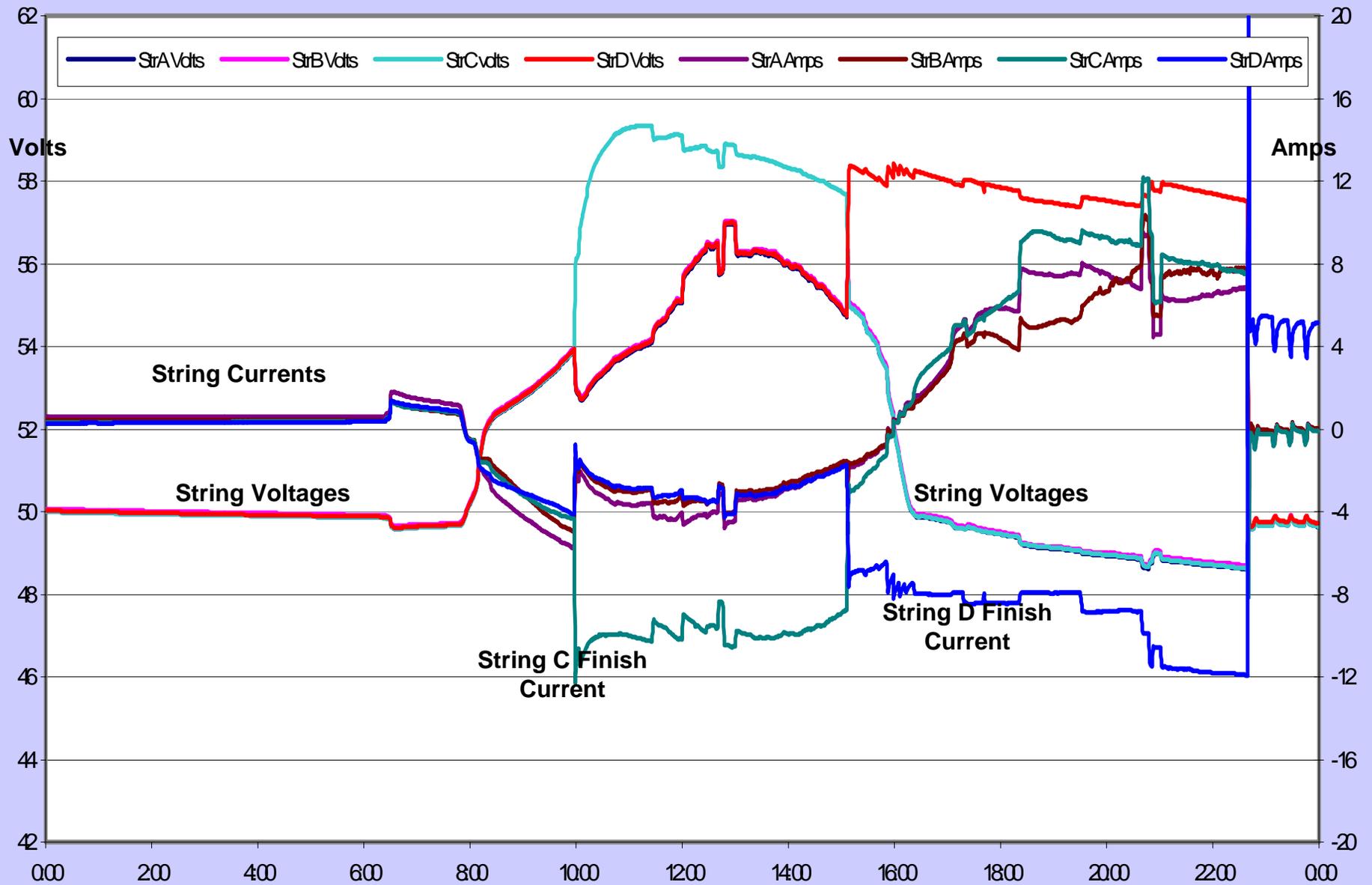
08/13/01 All loads on. Generator off just past midnight, Finish Charge ended at ~1AM, Generator on at ~6PM, off at ~10:30PM, Finish Charge ended at ~11:30PM



10/3/01 All loads off except for housekeeping and lights on 7-8PM. Strings A and B Finish Charged.
 Discharge currents shown positive, charge currents negative.



10/4/01 All loads off until 6:30AM, then refrigerator (continuous) and lights (on timer).
 Strings C and D Finish Charged.



AltConfigs FY01 Progress #2

- AltConfigs modeling (using Symons/EECI battery model developed earlier) continuing
- Type I AltConfigs Software being improved further on basis of experience in lab & field tests
- Notice of allowance of first AltConfigs patent received; new disclosures in process
- Possible “implementer” to commercialize Type I AltConfigs identified; negotiations on how to proceed underway

Next Steps

- **Continue testing of AltConfig units in EECI Lab (life test) and Field (performance test) and further refine Type I design as found necessary**
- **With Implementer, complete Engineering Development of Type I AltConfig; prepare to hand-off for commercialization**
- **Begin evaluation of advanced AltConfigs, including analysis of larger RGSs & acquisition of more detailed data from existing test sites**

Summary

- **Alternative configurations to optimize utilization of batteries in RGS have been conceived and Type I has been developed**
- **Type I AltConfig successfully tested at an RGS site with further improvements being made before and during this field test; testing here and in lab continuing**
- **Advantages expected for Alternative Configurations have been qualitatively realized and further benefits identified by a potential customer; further analyses underway**
- **Possible Implementer for Type 1 AltConfig has been identified; Engineering Development of a product has been initiated**
- **A list of recommended Next Steps has been developed, which includes a progression towards commercialization**